



CIAT Strategic Initiative on
Sustainable Food Systems

The **International Center for Tropical Agriculture (CIAT)** is proud to celebrate *50 years* of agricultural research and development impact

In 1967, the majority of poor and hungry people in the tropics were smallholder farmers. Increasing the productivity of their crops was, therefore, the critical entry point for CIAT's research. Since that time, we have been concerned with nearly every aspect of tropical agriculture: the crop varieties that farmers grow, the production systems they manage, the agricultural landscapes they inhabit, the markets in which they participate, and the policies that influence their options and decisions. Today, we also look forward at emerging challenges, with a renewed commitment to feed the planet and offer a better deal for both farmers and consumers.

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CGIAR is a global research partnership for a food-secure future. Its science is carried out by 15 Research Centers in collaboration with hundreds of partners across the globe.

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Cover photos

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Objective

The objective of this document is to outline the key elements of CIAT's strategic initiative on sustainable food systems. It explains how the concept of "sustainable food systems" will become an *integrating framework* for CIAT's research in the coming years, linking researchers from different groups and regions together through a coherent and focused research agenda that helps CIAT respond to emerging global development challenges and related international research priorities.

Within CIAT, our ambition is to become truly holistic in our conceptualization of modern global food, agriculture, environmental, and human health problems/challenges, while remaining focused with regard to our entry points for research that leads to solutions.

At the CGIAR level, our vision is one where CIAT becomes in the next 5 years the place "to-be," "to-collaborate with," and "to-fund," when it comes to sustainable food systems research, opening the door for the organization to establish a new host of partnerships with the health, nutrition, and environmental sectors.

At the global level, we aim that CIAT, working at scale together with its partners from the North and from the Global South, contributes to advance the knowledge and applied research necessary to address some of the key, emerging, and pressing issues related to the sustainability of food systems.

Why CIAT must engage in food system research

For CIAT, the *fundamental argument* for engaging in food systems lies in the recognition that adopting this agenda as an integrating framework offers an effective and inclusive pathway that can align our research agenda to current and future global development challenges and international research priorities.

To illustrate the strategic relevance of a food systems agenda for CIAT and more widely for CGIAR, we relate this part of the document to the CGIAR three System-Level Outcomes (SLOs) as defined in the CGIAR Strategy and Results Framework 2016–2030: (a) reduce poverty; (b) improve food and nutrition security; and (c) improve natural resources and ecosystem services. If we look closely at these three components from a historical and dynamic perspective, what can be learned?



School feeding program in Pucallpa, Peru (Adriana Varón/CIAT)

Important transformations have taken place in the world since CIAT's inception. Adopting a food systems agenda would offer the opportunity to adjust our agenda to modern food, agriculture, environmental, and health research priorities

Poverty reduction

In 1967 – the year CIAT was born – 90–95% of the poor were small-scale landholders/agricultural producers living in rural areas. The general model adopted at CIAT was one where poverty was fundamentally understood as a rural characteristic, particularly associated with low-productivity

subsistence farming. Consequently, CIAT, CGIAR, and the development community at large worked with agricultural producers as their main and primary target/beneficiaries.

In 2017 (50 years later), 70% of the poor live in rural areas, and 90% of them are still small-scale producers (meaning that those smallholders represent today about 65% of the world's poor). Following this trajectory, by 2050 about 50% of the poor will still be among those small-scale producers, but the other half will no longer directly participate in agriculture (Figure 1). Some may still live in rural areas but a growing proportion will live in small- to medium-sized towns or in slums in larger urban centers. In other words, poverty is increasingly no longer only a rural phenomenon, and is furthermore not concentrated solely in agricultural communities.

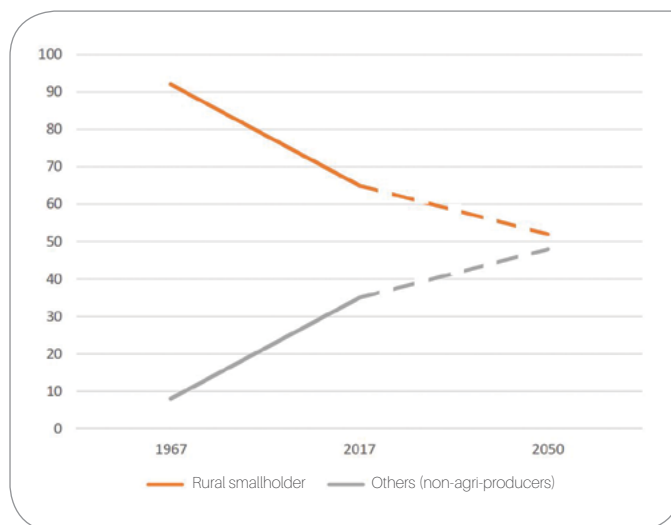


Figure 1. Who the poor are.

“Farmer or not farmer, this is the question”

By 2050, half the poor will no longer be rural agri-producers

Food and nutrition security

Today the world produces enough calories to feed 7 billion people. Yet, one person out of six is still food insecure, which in today's context, may not mean that they are subject to famine (as it might have been the case 50 years ago) but that their access to food is vulnerable to climatic, economic, or political shocks and stressors. In addition, 25% of children under the age of 5 are chronically malnourished (with up to 38% in South Asia), while 2 billion people are overweight (including 600 million obese).

What do those numbers mean from a research perspective? They mean that, in today's world, assumptions such as “sustainable intensification is what is needed to maintain future food security” or “healthy agricultural products lead to healthy diets” are too simplistic to resolve the food and nutrition security equation. These are, in fact, only part of the equation. Changes in diets, physical activity patterns, and food markets are leading to greater coexistence of over- and undernutrition, particularly in low- and middle-income countries.

In other words, food security or nutritious diets are no longer simply about productivity or even availability or affordability of food. They are also about quality and utilization and distribution of food, about rural and urban consumers' behaviors and preferences, about the incentives and disincentives of the food processors and sellers, and about

Today, critical questions of food and nutrition security include quality/ utilization and distribution of food, rural and urban consumers' behavior and preferences, and stability and resilience of urban food supply chains

stability and resilience of food supply chains in cities and in connected rural areas. We cannot simply aim to produce more products, even the most nutritious, or more climate-smart crops, and assume that this will solve food insecurity and improve human diets. As with poverty reduction, if CGIAR wants to continue having an impact on food security and nutrition at a global scale, we need to significantly widen our food security agenda.

Improve natural resources and ecosystem services

Today's food system (from production to consumption) contributes 19–29% of global greenhouse gas (GHG) emissions. While contemporary, conventional farming

continues to consume extremely significant fossil fuels, 30–50% of total GHG are generated by the “beyond-the-farm” component, and this figure is expected to continue to rise in coming decades – especially in low- and middle-income countries – as the value chains are getting longer and more sophisticated. In terms of energy consumption and associated impacts on natural resources through oil, gas, charcoal, or dam-generated electricity, farming represents just one-quarter of the whole food cycle, while processing, packaging, and wholesale and retail represent almost twice this amount (between 40 to 50%) (Figure 2).

In parallel, while we have successfully started to accumulate quantifiable evidence of the global impact of modern

agriculture on the environment (including the progressive decline in crop and wild relative biodiversity, and the rapid degradation of natural resource availability such as water or soil carbon), the same analyses systematically stress that the drivers and economic signals of many of those trends are to be found further down the value chain, in particular within the agri-food and food supply industry, and in consumers’ dietary change. This means that a true and full picture of “what it takes to feed the world,” with an account for the impacts/costs that this imposes on natural resources and ecosystem services, requires that we no longer focus solely on productivity, eco-efficiency, biofortification, and linking farmers to markets.

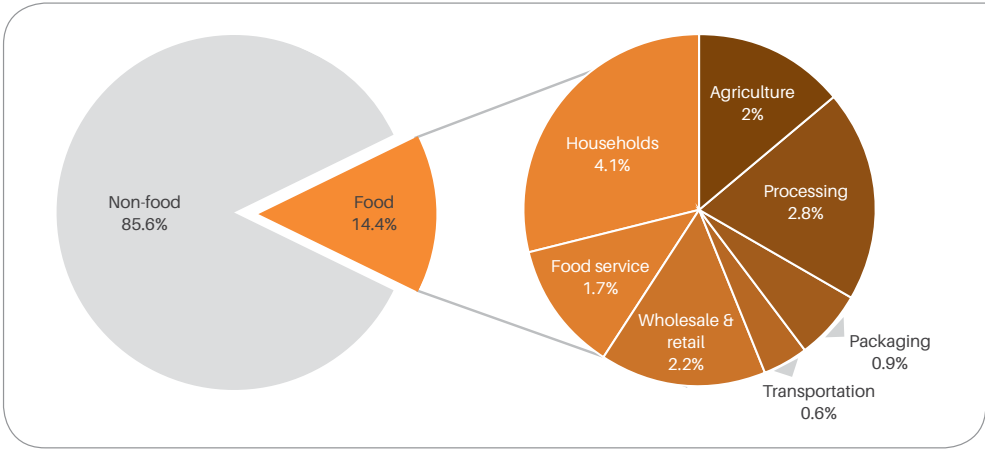


Figure 2. Energy consumption across the food system.

Box 1. The environmental impact of food systems

Food systems by default have an environmental impact but, with a growing population and changing diets, the different elements of the environmental footprint need to be managed. These are:

- Energy conversion efficiency from sunlight to kilocalories on the plate, including fossil fuel use and plant-to-animal transformation.
- Use of multiple species and landrace diversity in diets, including neglected and underutilized foods (e.g., seed, nuts, vegetables, fruits) that provide dietary quality.
- Agrochemicals, nondegradable plastics, additives, hormones, and other substances accumulating in the food trophic chain.
- Preservation of natural ecosystems as the agricultural frontier continues to expand into irreplaceable habitats globally.

Ultimately, even the most cursory analysis of what the world looks like today and where it is likely to be in 20 years time shows that if CIAT wants to continue to positively impact hundreds of millions of lives on the ground – and subsequently to continue to be a relevant research institution in relation to the strategic goals of CGIAR – it is imperative that it updates and widens its scope into a new food systems-based research agenda. We argue that adopting a food systems approach constitutes a strategic framework for such an agenda, positioning CIAT as a progressive agenda-setting research center of CGIAR.

What is a “food system” and what does this mean for CIAT?

An important core element of food systems is the set of different processes, activities, infrastructures, and institutions that are involved in the production, processing, distribution, and consumption of food. Food systems involve multiple actors (food producers, food-chain actors, policy makers, and consumers) participating in linked and nested decision-making processes. But food systems are more than that. They also include the feedback loops that account for the impacts of those different actors and processes on each other, as well as on the environment.

Like any system, food systems also involve scales and emergent properties (local to global) and so-called “hard systems” (i.e., nutrient flows) and “soft systems” (i.e., cuisine and food culture). In adopting the idea of food systems as complex, heterogeneous entities over space and time and replete with nonlinear feedback, our intention is to acknowledge the need for interdisciplinary research, combining both natural and social sciences.

Despite this apparent complexity, food systems are not more intricate or broader than the variety of topics that CIAT has embraced so far through its agenda. But food systems are vast to be adequately represented in one research agenda. CIAT cannot cover every single aspect of food systems thoroughly, and we aim to initially focus our attention on carefully selected topics. These should draw from and reflect



Cassava in urban street food, Hanoi, Vietnam (Georgina Smith/CIAT)

our understanding of where CIAT’s experience/strength and uniqueness lie, expanding these in specific directions that are relevant to the sustainable food systems agenda. These points are discussed in the following section.

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Our strategy is to focus our efforts on the areas of research where CIAT experience/strength and uniqueness lie or where high unattended demand is evident

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What are the specific advantages/niches for CIAT in relation to food systems?

CIAT’s research is characterized by an extraordinarily rich blend of disciplines – from genetics, soil sciences, and nutrition, to economics/policy, social sciences, and ecology – all of which are indispensable to a full comprehension and integration of the different dimensions of food systems and their interdependences.

CIAT has built its international reputation both within and outside CGIAR on its ability to embrace and adopt systemic/holistic thinking in many of the problems it addresses, and to

work across scales (from the micro, farmer-level to national, regional and global levels). CIAT is also internationally acknowledged for its capacity to co-design and co-deliver research and interventions with local and national partners (practitioners, private and public institutions, professional organizations, policy makers, and other key decision makers) on the ground and at national level. More recently, CIAT has been awarded for its ability to “handle” large multi-source data sets – and is co-leading the CGIAR Platform for Big Data in Agriculture.

These characteristics are key to CIAT’s ability to engage in the sustainable food systems research agenda, and represent important comparative advantages. CIAT’s global presence in countries (and cities) where food systems transitions are:

relevant also constitutes a powerful advantage. The Center's early involvement in food-based approaches to malnutrition through e.g. HarvestPlus, and in value chain for nutrition, as well as its recent work on crop origins and agrobiodiversity in global to local food utilization supply, are examples of its particular areas of expertise.

Box 2. Value chain for nutrition as a concrete example of CIAT work on food systems

The value chain for nutrition (VCN) approach is a good example of how CIAT can build a unique niche by making use of its multidisciplinary research capacities, linking innovative research on consumer and nutrition economics, food science, and post-harvest handling with participatory nutrition-sensitive value-chain assessment and upgrading methods. It conjoins CIAT's experience in nutrition research, value chain analysis, multi-stakeholder innovation platforms, and inclusive business models.

It works with partners' expertise in low-cost, energy-efficient technologies, combined with quantitative research on consumption patterns, consumer preferences, and willingness to pay for nutrition-relevant product attributes.

VCN contributes to CIAT's new strategic initiative on **Sustainable Food Systems** through an approach that enables specific methodologies to deliver nutritional outcomes, while shifting the emphasis of current commodity-focused efforts to improved dietary quality beyond biofortification, using a food basket approach.

Structuring our thinking

Identifying the key research areas where CIAT has indisputable comparative advantage and a strong research capacity is a critical step in building our strategy. It will allow us to stay focused, relevant, and effective. It is also important to start by structuring those various and diversified areas of research into a coherent framework. For this, three principles have been identified, which will help us to articulate our work more coherently and systematically across the diverse areas of sustainable food systems in which we will engage. Those three principles are: (a) efficiency, (b) nutrition, and (c) resilience.



Efficiency

The principle of efficiency resonates particularly well within CIAT as the core principle of the current *CIAT 2014–2020 Strategy* is “eco-efficiency.” But the concept

of eco-efficiency as presented in the 2014–2020 strategy document is one that is built around the idea of eco-efficient agriculture. We propose to embrace this agenda, and to expand it in order to reflect some of the early points made in this document. In particular, we recognize that beyond eco-efficient agriculture, the new agenda for this 21st century is about *eco-efficient food systems*. In that context, the way we understand efficiency is one where: “efficiency encapsulates the delivery of physically and economically accessible and safe food to consumers, while minimizing environmental damage and waste.”



Nutrition

Adequate nutrition is one of the key outcomes of food systems. In effect, much of the current research on food systems aims to improve the nutritional status of consumers. CIAT, through its major input into HarvestPlus and its work on value chains for nutrition, is already greatly contributing to this nutrition ‘dimension.’ We, however, propose to expand on this path with a more holistic vision, in which our definition of nutrition is one where: “nutrition focuses on nutrient adequacy with a particular emphasis on understanding the complex role of diversity both in production and consumption in leading to increased human health outcomes.”



Resilience

Even if resilience has not yet been formally embraced by CGIAR as a potential structuring concept for the new phase of its research programs, its widely and exponentially growing use in the rest of the research community, in relation to domains such as climate change, food security, or environmental and ecosystem ecology, confirms its pertinence. We argue that resilience provides an extremely relevant principle for analyzing food systems. In our view, resilience in relation to food systems: “encapsulates the relationship of cities to their food sheds in terms of environmental sustainability, and stability of production of diverse foodstuffs in the face of economic, political, or environmental shocks and climate change.”

What research areas will CIAT focus on?

The following three domains will constitute CIAT's initial entry points into the sustainable food systems agenda:

1. *Traditional/informal actors of the food system.* CIAT's Linking Farmers to Markets (LFM) research team has developed a robust reputation based on their long-standing work on inclusive value chains and the success of their LINK methodology, and more recently

on value chains for nutrition. Their own analysis (along with others) shows that traditional (or informal) markets and values chains – i.e., those involving the poorest, most vulnerable and least organized producers and consumers – are not only still prevalent in most of the developing and emerging countries, but that a large majority of poor consumers in both rural and urban areas depend heavily on those traditional markets for their food and nutritional security.

Yet, when it comes to research on food systems, the attention among a large number of academics, donors, and policy makers has focused so far mainly on formal markets (for instance, on the “supermarketization” of the food supply). In this context, the neglected, yet critical traditional markets could become a highly relevant and distinctive area of focus for CIAT’s research on value chains and markets in the new context of food systems transformation.



The vast majority of the poorest (in both rural and urban) areas still depend heavily on traditional markets for their food and nutritional security



2. ***From agroecosystem integrity to diet and back again.*** Although food systems’ sustainability embraces many dimensions (social, cultural, etc.), agroecosystem integrity is one we propose to start with.

Agroecosystem integrity – the temporal and spatial preservation of the diversity and functionality of the different agroecosystem components (e.g., species assemblages, energy flows, and net nutrient balance) – has always been a cornerstone of resilient rural food systems and will continue to play a critical role in providing the resource base for varied, locally adapted, and culturally appropriate domesticated and wild harvested foodstuffs.

Our view is that a robust understanding of sustainable food systems is one that recognizes that food systems and agroecosystem integrity are inextricably connected in a two-way relationship: first, through the dependence of the farming/production systems on the agroecosystem integrity, and second, through the impact that food systems and human diets have on the environment (what we would like to call the “system food-print”).

In other words, our conceptualization of sustainable food systems is one that emphasizes the circular nature of the

system (“from agroecosystem integrity to diet and back again”), going well beyond the linear “farm to fork” or “farmer to consumer” approaches that is popular in the current literature.

We propose that this circularity becomes one of the distinctive characteristics of CIAT’s approach to food systems. In this context, CIAT’s recognized experience on agrobiodiversity, in the form of genetic diversity in crops, used by plant breeders via robust seed systems and based on genetic resources conserved in genebanks, its work on ecosystem services, forages systems, soil conservation, and land restoration, and its emerging reputation as an analyst of agrobiodiversity within food supplies worldwide, offers a strong foundation on which we can build this distinct approach.

3. ***Combining big data with food system diagnosis and foresight.*** Some of CIAT’s most significant research successes in the last 5 years come from designing and implementing analyses based on large data sets, where spatial information related to productivity was linked with environmental or climate change information to conduct diagnostic or foresight exercises.

Box 3. How soils are linked to food systems

Soils play a crucial role in healthy food systems and soils research is essential for a strong food systems research agenda. Regulating and provisioning services of soils are perhaps the most obvious entry points for our scientific approach to studying food systems with the aim of supporting sustainability in the face of multiple global and local changes. Maintaining and enhancing the regulating services ensures agroecosystem productivity and is key to enhancing the efficiency of agroecosystems. These services are also important to successfully dealing with some of the more important waste management issues in the food system, particularly those closer to the sites of production and primary transformation.

Provisioning services are important in some value chains where soil products or cultures from particular regions have value. The importance of local microbial assemblages on the quality of high-value products, such as wine, beer, and cheese, is poorly understood and poses unique challenges in food systems that have imbedded cultural values in the face of global environmental change. Currently, much of the research on the services of soils focuses on defining these services and valuing them, and much more is needed to improve our understanding of the two-way relationships between land/soil and consumers through the effect of food systems.

There is an urgent need to conduct similar analyses in relation to food systems. While some work has been carried out at the local and landscape level by other CGIAR Centers, very little is known at the macro to global level about the potential relations between the drivers of food system transformation (urbanization, change in income or lifestyle, intensification and homogenization of farming systems, or climate change) and their impacts on the effectiveness of food systems measured in terms of food security for the urban poor, dietary diversity, and diet-related disease, or on its sustainability. Relying on its well-established expertise and its future role in the CGIAR Big Data Platform, CIAT is in a unique position to become one of the leading

research organizations in the implementation of such global analyses.

Finally, our initial intention to focus on those three entry points does not mean that we do not intend to engage in other domains relevant to food systems in the future as well. In particular, the social dimension of food systems, which embraces both the gender and the political economy/equity elements, is another domain that we recognize is essential for comprehensively addressing food systems' challenges. We, therefore, intend to develop capacities around this social/political economy dimension in the near future in order to engage more effectively in this area.



Community nutrition program in Madagascar (Stéfanie Neno/CIAT)

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The central challenge for the coming decades will be to deliver healthy diets, but also to ensure the sustainability of the systems that deliver those diets

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Not just a food system – but a sustainable food system

A critical and distinctive element of CIAT's approach to food systems is that this approach goes beyond just food systems per se and its direct outcomes in terms of nutrition and human health. A food system that is successful at delivering nutritious/healthy products to consumers, but does it in an unsustainable way, is not desirable. In essence, the challenge is not simply about the promotion of healthy diets; it is also about the sustainability of the systems that deliver them. Our conceptualization of food systems is, therefore, one that emphasizes the importance of the sustainability of those food systems and recognizes that the central challenge for the coming decades will be to deliver healthy diets, but also to ensure the sustainability of the systems that delivery those diets.

Box 4. CIAT definition of sustainable food systems

"Sustainable food systems are those food systems with low environmental impacts, that contribute to food and nutrition security and to healthy diets for present and future generations. Sustainable food systems are protective and respectful of biodiversity and ecosystems, as well as human well-being. They provide culturally acceptable, economically fair, affordable, nutritionally adequate, safe and healthy foods in a way that balances agro-ecosystem integrity and social welfare."

What products and outputs will CIAT propose?

We will continue to deliver the many products and outputs that CIAT has been developing and delivering through its current programs and activities (which range from heat-tolerant beans, smart agriculture assessment tools, β -carotene-rich cassava, to crop modeling for farm-scale decision-making for improved agronomy). But the sustainable food system agenda, when used as an overall, integrating framework, will provide us with a more coherent overarching narrative for these different products.

In addition, CIAT will be in the position to rapidly deliver a series of new products and outputs in relation to this new agenda on sustainable food systems. They include:

- ✓ **Tools and methods developed for food system analyses:** What do a sustainable food system's minimal metrics at different scales look like? How do we measure and track transitions in food systems? The development of standard procedures, key metrics and data(bases) of food systems at the global, national (key country) and subnational level will be an essential starting point. One of the first outputs in this area will be a characterization of food system sustainability at the global level, where a generic framework will be developed to explore and test potential relationships between multidimensional indicators of food system sustainability and indicators of food system drivers. This will be funded under the Food Systems for Healthier Diets (FSHD) flagship (as part of the CGIAR Research Program on Agriculture for Nutrition and Health [A4NH]). Another opportunity will be to design, field-test, and disseminate a LINK package that is adapted to informal/traditional market actors.
- ✓ **Innovations tested and validated for sustainable food system upgrading:** Relying on our strong capacity to engage at the local level and implement applied research and interventions with partners on the ground,

we can field-test specific interventions, such as those currently tested through the BMZ project "Making value chains work for nutrition" implemented by the LFM team in Africa; or the activities that will be carried out as part of the FSHD flagship implemented in collaboration with Wageningen University and national partners in Vietnam.

- ✓ Development of a series of **spatial decision-support tools, ex-ante evaluation/foresight, and modeling** of the interdependence between changes in food systems and impact on producers, consumers, and the environment at different scales (national, regional, and global). These products will be built progressively as our own understanding of the links between food systems and environment and consumers' behavior improves, and this progress is translated in geospatial model and databases. A good example of this is the current collaboration being established with the University of Michigan with the objective of integrating openly available agricultural statistics, health, and environment data and test how useful it is in helping policy makers to make country-level policy decisions.
- ✓ **In-depth research on food systems in key "zoom-in" sites**, particularly cities linked to rural/global food chains. Based on our current activities, 'natural' candidates for those zoom-in case studies include Hanoi in Vietnam, where we will be working through the FSHD flagship; Cali in Colombia, where several initiatives/studies have already been completed and more are planned for 2017; and different places in Kenya and Uganda, where CIAT has a strong presence on the ground through several VCN projects/activities. In all those cases, the underlying assumption is that better understanding of the different dynamics, and appropriately-dialogued-with-actor platforms, will lead to recommendations for improved city-region food system policies.



Soils play a crucial role in healthy food systems (Georgina Smith/CIAT).

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